Issued February 10, 1914.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

SOIL SURVEY OF THE HOOD RIVER-WHITE SALMON RIVER AREA, OREGON-WASHINGTON.

BY

A. T. STRAHORN AND E. B. WATSON.

MACY H. LAPHAM, INSPECTOR IN CHARGE WESTERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1912.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1914.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Soils,
Washington, D. C., May 29, 1913.

Sir: One of the projects undertaken by the bureau during the field season of 1912 was the survey of the Hood River-White Salmon River area, Oregon-Washington. This survey was requested by many prominent citizens of the area.

I have the honor to transmit herewith the manuscript report and map covering this area and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1912, as provided by law.

Respectfully,

Milton Whitney,
Chief of Bureau.

Hon. D. F. Houston,
Secretary of Agriculture.

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FIGURE.

FIG. 1. Sketch map showing location of the Hood River-White Salmon River area, Oregon-Washington 5

MAP.

Soil map, Hood River-White Salmon River sheet, Oregon-Washington.

SOIL SURVEY OF THE HOOD RIVER-WHITE SALMON RIVER AREA, OREGON-WASHINGTON.

By A. T. STRAHORN and E. B. WATSON.

DESCRIPTION OF THE AREA.

The Hood River-White Salmon River area covers about 226 square miles, or 144,640 acres, of mountain, valley, and river-bottom land in or adjoining the Hood River and White Salmon River Valleys, in the States of Oregon and Washington.

The Hood River Valley is a depression of irregular outline lying in Hood River County in the central part of Oregon. It is just west of the principal axis of the Cascade Range, and is bordered on the east by a low spur of that range.

Mount Hood, with an elevation of 11,226 feet above sea level, marks the extreme upper or southern end of the valley, and its permanent

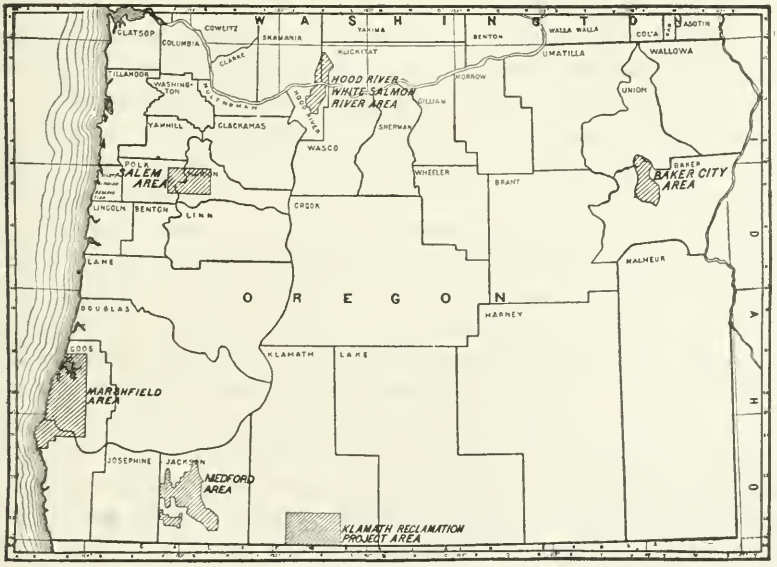


FIG. 1.—Sketch map showing location of the Hood River–White Salmon River area, Oregon–Washington.

mantle of snow and ice contributes not only to the flow in Hood River and its numerous tributaries, but also to that of a number of streams lying west of the Cascades.

Hood River is a perennial stream, flowing over rocks and bowlders, and because of its rocky, timbered gorge is considered one of the

most picturesque streams in the Northwest. For about 18 miles above its confluence with the Columbia it follows a single channel carved deep in the country rock. Above this point several branches flow into the river from the Cascade Range, from the northern and eastern slopes of Mount Hood, draining a region covered with dense virgin forest. (Pl. I.)

The so-called Hood River Valley is a basin, the surface of which is a series of plateaulike flats, lying at elevations of 100 to 500 feet above the beds of the streams and inclosed by the steeply sloping sides of the adjacent mountains and hills. It is divided into three more or less distinct and conspicuous topographic divisions, known as the Upper, Middle, and Lower Valleys. The land surface of the extreme southern part of the valley, or Upper Valley, is that of a dissected plain, having a pronounced northward slope. It extends northward to the confluence of the drainage courses or to a prominent ridge occurring in the central part of T. 1 N. This elevation, a short distance from Mount Hood post office, forms the boundary between the Upper and Middle Valleys.

The Middle Valley consists of but a few hundred acres of gently sloping land, the drainage of which is northward through Neal Creek Canyon into Hood River.

A somewhat precipitous mountain, east of Hood River, having an elevation of about 3,000 feet and extending eastward from near Bloucher and Trout Creek on the Mount Hood Railroad, with a low ridge between it and the mountains along the eastern margin of the area, forms the boundary between the Middle and Lower Valleys. Along the northern slope of this ridge there is a small plateau, known as Willow Flat, extending from Odell Creek eastward to Neal Creek. This plateau is bounded on the north by a steep slope, which is nearly coincident with the boundary between the Underwood loam and the lower lying Hood silt loam, just south of Odell. (See soil map.) From this northern boundary of Willow Flat and the spur of mountain near Bloucher and extending northward to the Columbia River lies what is known as the Lower Valley. With the exception of the deep, tortuous channels of the streams and a few minor elevations, such as Van Horn Butte and Lentz Butte, the land surface slopes quite uniformly to the northward, and the larger part of it is without any marked irregularities. The elevation of this part of the valley is from 500 to 1,200 feet above sea level.

The Hood River Valley is bounded on the north by the intrenched valley and gorge of the Columbia River. The level portion of the valley is separated from this gorge by precipitous walls of basalt and by steep rocky slopes following an irregular line one-half mile to a

mile from and roughly parallel to the course of the stream. Although a part of these slopes is not too steep for cultivation, other conditions are seldom favorable. Between the steep and precipitous slopes and cliffs and the Columbia River there is a long, narrow area of land, lying but little above the usual level of the water in the stream. The surface of this strip is more or less gullied as a result of annual overflows, and in the lower places marshy conditions exist for a greater part of the year.

On the western side of the valley the mountains rise abruptly from the valley floor to elevations of 4,000 feet or more above sea level. The lower slopes are included within this survey. From Bloucher southward along the main channel of Hood River to the mouth of the West Fork of that stream and along the latter fork the mountains rise almost precipitously from the stream and vertical cliffs of columnar basalt are frequently exposed.

The low range of mountains which forms the eastern boundary of the Hood River Valley represents a spur of the Cascade Range, branching out near the base of Mount Hood and terminating in rocky bluffs or to nearly vertical cliffs along the Columbia River. The western slopes of this range, some of which are included within the survey, are mainly too steep for cultivation, are generally rocky, and are less heavily timbered than the mountains on the western side of the area.

That portion of the area including the White Salmon River Valley in the State of Washington lies directly across the Columbia River from the Hood River Valley in Oregon. A few square miles in the southwestern part of this section of the area lies in Skamania County and the remainder is in Klickitat County. The term White Salmon Valley, as generally used, refers to the drainage basin of the White Salmon River. There is but little land included within the present valley of the White Salmon River in this portion of the area, and this consists of a narrow, irregular strip on each side of the river. The balance of this portion of the area consists of rolling or undulating land, intrenched by the present stream valley and surrounded by hills and mountains with moderate to steep slopes.

At the extreme northern end of the valley is Mount Adams, with an elevation of 12,470 feet above sea level, whose upper slopes are covered with perpetual snow and glaciers. The White Salmon River receives the drainage from its southern and southwestern slopes, and following a southerly course enters the Columbia River at a point nearly opposite the mouth of the Hood River. The gradual melting of the snow and ice affords a never-failing supply of water in the White Salmon River.

From the mouth of the White Salmon River northward for about 3 miles the channel is confined to a narrow, rocky gorge with precipi-

tous to vertical walls of basalt. Above that point nearly to the northern boundary of T. 4 N., R. 10 E., the river has a shallow, rocky bed, and the adjacent land is the sloping and rolling floor of a slightly elevated, eroded valley. Above the southern part of section 12 of this township the stream is again confined in a narrow canyon, the walls of which are commonly vertical and from 20 to 75 feet in height.

No streams of any importance enter the river from the west, as the crest of the watershed between the White Salmon and Little White Salmon Rivers is but a few miles distant and there is not enough surface drainage to form large or permanent streams. In the eastern part of the valley there are two streams tributary to the White Salmon—Rattlesnake and Gilmer Creeks, which are of considerable size, and drain extensive areas of mountain and hill land along their courses.

With the exception of a single narrow body of alluvial soil just south of Bingen, the Columbia River, on the Washington side, is bordered either by a steep, rocky slope, or by vertical walls of columnar basalt, which in many places rise directly from the margin of the stream. On the slopes above these cliffs north of Underwood and Hood, situated at the foot of the cliffs in the Columbia River gorge, and near the town of White Salmon upon the bluff, there are areas of relatively level bench or terrace lands, and these, together with the gentle undulations and slopes and level areas of lower lands along the White Salmon River, form practically all of the area that can be called reasonably level. The remaining part of the area in Washington is made up of the mountain and hill slopes, with varying declivities, not uncommonly too steep for cultivation, and often traversed by deep ravines. On the crests of the ridges, where dissection has not reached an advanced stage, there are small, irregular sections of land where the slopes are not pronounced, but such areas are seldom of great extent and are of little importance agriculturally.

The crests of the mountains, the lower slopes, and the larger part of the floors of both valleys were originally covered with a dense growth of pine and fir. (Pls. I and II.) Along the stream bottoms the native vegetation is so dense as to approach the character of a jungle, cottonwood and willow being the principal trees, with an impenetrable undergrowth of vines and brush.

Prior to the advent of white settlers this portion of the Northwest was inhabited only by scattering tribes of Indians, who subsisted upon the roots, bulbs, and seeds of a variety of native plants and upon fish caught in the Columbia River and tributary streams. More or less opposition was offered by the Indians to the immigration of the whites, but excepting on two or three occasions, when their attacks were unusually severe and led to organized campaigns against them,

GORGE OF THE HOOD RIVER, SOUTH OF DEE, SHOWING FOREST GROWTH ON THE SOILS OF THE UNDERWOOD SERIES.

[Photograph by U. S. Forest Service.]

VIEW IN THE UPPER HOOD RIVER VALLEY, ABOUT 2 MILES WEST OF PARKDALE, OREG., SHOWING TOPOGRAPHY AND FOREST GROWTH ON PARKDALE LOAM.

[Young orchard on the cleared land. In the immediate foreground is an area of rough stony land. The hills in the distance are covered by the Underwood loam.]

their resistance was confined largely to the harassing of lonely settlers and prospectors in the more distant parts of the mountains.

Agents of the Hudson Bay Co. explored the Northwest early in the nineteenth century, but it was mainly through the expeditions of Smith (1828), Lewis and Clark (1804–5), the Hunt (Astor) party (1810–12), and Fremont (1843–44) that definite knowledge of this part of the country was obtained. Settlement began in this area late in the sixties, when a small village sprung up at the mouth of the Hood River and became a stopping place for travelers on their way to the coast. When the Columbia was used for water transportation this town became one of the regular stopping places for the steamers. With the building of the railroad along the south bank of the Columbia River, rapid transportation became available, and the agricultural development of the valley, which had been slow and irregular, progressed rapidly, the type of agriculture changing from the production of hay and the grazing of cattle to the production of fruit.

On the Washington side of the river settlement has been much slower. Water transportation has been available for many years, but the desire of the larger number of people to be near the railroad has retarded the development of that section. In 1908 the Spokane, Portland & Seattle Railway was constructed along the north bank of the Columbia River, and railway connection with the commercial centers of the Northwest is now available for that part of the area.

The town of Hood River is the county seat of Hood River County, and the principal business center of this part of the State. This town has a population of 2,331, according to the census of 1910. Most of the fruit-packing houses of the valley are located at Hood River, since practically all of the fruit is shipped by railroad from this point. Hydroelectric plants furnish electricity for lighting and power purposes, and the domestic water supply of the city is derived from a number of springs in the Cascade Range. The main line of the Oregon-Washington Railroad & Navigation Co. connects the town with the eastern and western business centers, and a local line, the Mount Hood Railroad, owned by a lumber company, traverses the Hood River Valley, connecting Hood River with the town of Parkdale, a small settlement in the upper valley. Van Horn, Lentz, Odell, Summit, Bloucher, Winans, Dee, Trout Creek, and Woodworth are intermediate stations along this line. Oak Grove, Fir, and Mount Hood are crossroad stores. Ruthton, a station in the western part of the area on the Oregon-Washington Railroad & Navigation Co.'s line, is the site of an important lumber mill, which receives the lumber from the nearby mountains.

The town of White Salmon, with a population of 682, is the principal commercial center of the White Salmon River Valley section of the survey. This town is located on a sloping bench sev-

eral hundred feet above the Columbia River and about a mile by wagon road from the railroad station of the same name. From the town of White Salmon wagon roads lead to all parts of the valley and connect with distant agricultural sections in adjoining valleys. Hood, Underwood, and Bingen are small stations along the line of the Spokane, Portland & Seattle Railway, locally known as the North Bank Railroad, and afford passenger and freight facilities for adjacent sections of the valley. Husum and Gilmer are post offices in the central and northern parts of the valley, on the main traveled roads.

The main roads throughout the valley are excellent, and it is only during unusually severe winter weather that travel is obstructed even on the second-class roads.

CLIMATE.

The climate of this part of Oregon and Washington is characterized by moderate winters, long, cool summers, a moderately abundant rainfall, and comparative freedom from damaging spring frosts.

The precipitation is much less than that upon the western slope of the Cascade Mountains. There is a rainy and dry season. The former may be regarded as extending from late October to about the first of May. Showers occur at intervals throughout the summer months, but they are slight and seldom of much importance as a source of moisture supply, and from the middle of June to late in October the occurrence of rain in amounts sufficient to interfere with farming operations is very unusual. Rains are seldom accompanied by lightning, hail, or violent winds, and a large part of the precipitation takes place in the form of a fine mistlike rain.

Snow falls during January, February, and March. It appears first on the peaks and higher ridges of the surrounding mountains, and, as the season advances, slowly descends and spreads over the floor of the valleys. The depth varies considerably from year to year, the fall sometimes being heavy enough to cause serious injury to young fruit trees.

All of the rains and the larger part of the snows drift in from the west, coming up the gorge of the Columbia River. Owing to the irregular topography of the two valleys included within the area surveyed, there is commonly a wide variation in the amount of precipitation in various sections, and this is apparently not governed entirely by the altitude of the sections, but by the movement of the winds as affected by the arrangement of the mountain ridges. This condition is particularly noticeable at either the close or opening of the rainy season, when parts of these valleys receive heavy rains and other parts at no great distance may receive none.

Statistics of the weather conditions in these valleys given in the table below are compiled from the records of volunteer Weather Bureau observers in the vicinity of Hood River.

Statistics of climate compiled from records kept at Hood River, Oreg.

Year.	Temperature.			Precipitation.			State of weather.				Snowfall.	Direction of wind.	Killing frost.	
	Annual mean.	Highest.	Lowest.	Annual.	Maximum monthly.	Minimum monthly.	Clear.	Partly cloudy.	Cloudy.	Rainy.			Last in spring.	First in fall.
	° F.	° F.	° F.	*Inches.*	*Inches.*	*Inch.*	*Days.*	*Days.*	*Days.*	*Days.*	*Inches.*			
1899	49.2	98	— 6	44.18	7.72	T.	.....	.....	.....	142	79	W.	.....	.....
1900	.....	98	.....	.....	.....	.....	.....	.....	.....	.....	.....	W.	Apr. 27	Sept. 2
1901	51.3	103	14	36.88	7.81	T.	146	127	92	119	47.5	W.	Apr. 24	Nov. 2
1902	49.9	98	— 3	41.99	10.56	0.01	133	108	124	142	64.6	W.	Apr. 13	Sept. 29
1903	50.0	99	13	30.22	8.94	.07	143	119	94	106	34.6	W.	Apr. 19	Oct. 15
1904	52.6	102	19	35.23	8.96	.13	129	124	110	130	62.1	W.	Apr. 23	Oct. 20
1905	51.6	95	2	25.02	4.81	.05	147	114	104	120	43	W.	Apr. 11	Oct. 19
1906	53.0	106	14	35.71	10.54	.00	134	95	136	122	34	W.	Apr. 12	Oct. 20
1907	51.1	103	— 5	33.43	8.60	.10	170	65	130	111	78	W.	Apr. 30	Nov. 3
1908	.....	101	.....	.....	4.47	.05	.....	.....	.....	.....	.....	W.	Apr. 28	Aug. 31
1909	48.6	101	—18	28.48	11.75	T.	173	64	126	74	99.1	W.	May 9	Oct. 15
1910	50.4	101	1	21.47	7.70	.00	198	42	125	71	27	W.	Apr. 15	Oct. 25
1911	49.5	106	10	18.61	4.20	.00	210	35	120	55	36	W.	May 11	Oct. 27

The figures given in the following table are compiled from Weather Bureau records covering a number of years and show the average monthly temperature and precipitation at Hood River:

Normal monthly and annual temperature and precipitation, Hood River, Oreg.

Month.	Temperature.	Precipitation.	Month.	Temperature.	Precipitation.
	°F.	*Inches.*		°F.	*Inches.*
January	33.9	6.39	August	66.7	.24
February	36.2	4.92	September	59.3	1.53
March	42.4	3.68	October	51.6	2.61
April	50.0	2.13	November	42.2	5.66
May	56.3	1.25	December	35.9	7.42
June	60.9	1.02			
July	67.2	.18	Year	50.2	37.03

Winter temperatures are not ordinarily severe and, although the night temperature is usually below 32° F., it seldom falls below zero. The summer season is marked by relatively cool days and nights. The thermometer may rise above 90, possibly to 100° F., but such extremes seldom persist for more than a few days, and are succeeded by periods of cooler weather when the maximum daily temperature will rarely go above 80° F.

The usual spring conditions are such that there is but little danger of injury to the apple crop from late spring frosts, as a number of consecutive days with temperatures high enough to start the tree

growth seldom occur before the usual date of the last killing frost. Certain other fruits, such as peaches and grapes, may be forced into bloom by a few warm days early in the spring, and these may suffer severely with a subsequent lowering of temperatures. The dates of killing frosts in the spring are extremely variable in different portions of the valley, owing to differences in elevation and the conditions of air drainage. For this reason the data given in the table are applicable only to a small part of the valley immediately adjoining the upper part of the town of Hood River.

The prevailing winds are from the west, as the gorge of the Columbia River plays the part of a gigantic flue and affords a passage for the wind from the cool coast country eastward toward the heated interior. The velocity of the wind is least during the winter season, when the temperatures on the coast and in the interior are more nearly equal, and greatest in the spring and early summer, when the temperature in the plains section east of the mountains is much higher than that along the coast. The usual drift of the wind from the coast toward the interior is the principal factor in maintaining the low temperature of the summer season and in preventing excessively low temperatures during the winter. It is only when the normal conditions are disturbed that there is any noticeable movement of air from the interior toward the coast, and whenever this occurs the extremes of temperature for the season follow. In the summer season the winds from the heated plains to the east cause the thermometer to rise above 90°, and this heat will persist for one to three or four days. With the winds from the interior during the winter season the temperature drops, but in a few days the wind swings into the west and the severe temperature is replaced by a noticeably warmer period.

The average climatic conditions which exist in these valleys are such that the production of berries, deciduous fruits, and forage crops that are adapted to a cool, temperate climate will be profitable, providing, of course, that suitable locations are chosen.

AGRICULTURE.

The first settlers in these valleys occupied the comparatively level, elevated floors of the valleys and also the narrow bodies of alluvial soil along the Columbia River. The absence of accessible markets limited the activities chiefly to stock raising. In the districts mentioned grain could be grown for hay, and the stock were ranged over the adjacent lands of the valley and on the mountain and hill slopes, where, when the forest was not too thick, a good growth of grass afforded grazing during the greater part of the year.

A few trails and wagon roads led from the settlements to distant points in the valleys, but access to outside markets was available only by steamers on the Columbia River. The town of Hood River and

the old town of White Salmon originated as small settlements near the steamer landings where freight was received and shipped, and became the social and commercial centers of these two valleys. For years there was scarcely any increase in the size of these villages, and but little increase in the rural population, and when the railroad was constructed down the south bank of the Columbia River, Hood River was a village with a population of less than 300.

In the Hood River Valley the first attempts at producing what might be called a cash crop were made in the early eighties, when strawberries were grown on the west side of the valley and irrigated by a canal constructed by the farmers. This was practically the only agricultural product shipped from the valley for many years, and the early growers, realizing the need for cooperation and systematic marketing, organized what was known as the Fruit Growers' Union, and, although the crops of the valley have increased and varied in character from time to time, some form of shipping association has existed from that time to the present. Different kinds of deciduous fruits were planted by the early settlers for home use, but it was not until late in the eighties that commercial orchards were established. About this time one orchard was set out on the west side of the valley and two on the east side, though many at that time doubted the feasibility of growing fruits on an extensive scale.

In the White Salmon Valley, the earliest settlement was well up the White Salmon River, toward Trout Lake, where stock raising was made the principal industry. Owing to the elevation, the growing of grasses and alfalfa to be fed to stock and dairy cattle is still the leading type of agriculture.

Besides the isolation of these valleys, which was one of the principal features in retarding their development, the fact that practically the entire area of cultivable land was covered with a dense forest hindered progress. The early farming was confined to areas where there was little or no timber. The earliest clearings were around the site of the settlers' cabins. As there was no special need for the cultivation of large fields, the clearing of these small tracts was the only work done for many years toward removing the forest. As the population increased and markets became available, the timber was rapidly removed from the more level lands in both valleys, until, in the Hood River Valley at least, the area of forested land in the valley flat is at present very small. As the demand for land increased, the high prices asked for the valley land forced newcomers to the slopes of the mountains and into the upper Hood River Valley, and the clearing of these lands is still in progress.

In the White Salmon River Valley, owing to the lack of adequate transportation, the settlement and development has proceeded very slowly. From the first settlement, in the vicinity of Trout Lake, the

development has extended southward along the White Salmon River, where the lands, although heavily timbered, were fairly moist and could be made to produce heavy yields of the common forage crops. As fruit growing increased in the Hood River Valley and proved to be highly profitable, residents and newcomers in the White Salmon River Valley followed the example of their neighbors across the river, and this led to the clearing of areas on the timbered slopes and the crests of the lower ridges.

Aside from the change from stock raising to the growing of fruits, there has been no great variation in the type of agriculture in these sections. The different fruits have, as a rule, given regular yields, and, as a result, the principal development of agriculture in these valleys has been toward the production of fruit. So pronounced has been this tendency that at present much of the farm produce used in these valleys is shipped into the area.

With minor exceptions no attention has been paid to the adaptation of crops to the various types of soil, and only when the conditions were absolutely prohibitive of tree growth has there been any hesitation about the planting of some variety of deciduous fruit. Under such a system crop rotation is absolutely out of the question, excepting such changes as may be made from time to time in the crops grown between the rows of fruit trees.

The labor problem is a matter of concern to the growers only during the picking season, as the planting, cultivating, and spraying calls for but few men and the demand is easily met by the usual itinerant workers. In occasional years, when the climatic conditions are such that strawberries ripen suddenly, it is sometimes difficult to secure pickers to save the crop, but in the fall the apple-picking season lasts through several weeks and the supply of help is usually ample.

The wage of an ordinary farm hand, in this section, is from $35 to $40 a month and board, or $50 a month without board. Berry pickers are paid by the box, and a day's pay will run from $2 to $4, depending upon the efforts of the laborer. During the apple-picking season the pickers receive $2.50 a day and board.

Land holdings in this area vary from tracts of 5 acres to several hundred acres, the latter commonly being held by individuals or companies engaged in the development of large orchard tracts. In the developed sections of the valley 40 acres constitute a large farm, and the greater number of the orchards are in 10 to 40 acre tracts. In the undeveloped portions of the area a greater number of the holdings were originally quarter section homesteads, and a large proportion of the original entrymen have disposed of their holdings either to lumbermen or to real estate operators and develop-

ment companies, and there are now a number of such holdings which are 1,000 acres or more in extent.

Experience in this and in other sections has fully demonstrated that the best and most satisfactory results are obtained from small orchards operated by the owners, and the tendency here is to reduce the holdings to tracts not exceeding 20 or 40 acres in extent, and the preference is for the smaller size.

Unimproved land is, generally speaking, held at a rather excessive figure. It may occasionally happen that unimproved land, always in this area covered with forest or brush, may be sold at $100 an acre, but the land is usually held for $150 to $300 an acre, and in some cases the latter figure has been obtained for favorably located tracts. When everything is considered—expense of clearing, cost of the trees and of planting, pruning, and spraying until the trees come into bearing, taxes, and interest on the investment—the cost of a bearing apple orchard would be almost too great to justify the price asked for this land.

Throughout these valleys the general appearance of the farmhouses and outbuildings and the neatness of the surroundings is a matter of favorable comment by all who visit the developed sections. It is the exception to find an unpainted or poorly kept house in the orchard section, and a considerable number of the houses are large and modern in every respect. Here and there, particularly in the outlying sections where the original homesteads still remain, log houses and indifferently kept frame houses may be found, but these are rapidly being displaced by modern structures.

At present the agricultural output of these two valleys is practically limited to apples and strawberries. A few head of stock are occasionally shipped to Portland, and there is a small and unimportant shipment of pears, peaches, and plums. In driving through the Hood River Valley one passes mile after mile of orchards in all stages of development, with here and there small acreages of strawberries, planted either separately or in rows between the smaller fruit trees. In the outlying sections, which include the mountain slopes and portions of the upper valley, there are large areas of forested and logged-off land, but these are rapidly being cleared and giving place to young orchards. In the White Salmon River Valley the extent of the orchard planting is much smaller than in the Hood River Valley, but this is largely due to the retarded development of this section, caused by the longer deferred building of railroads. The lands that were first cleared and devoted to the production of grain and hay are being rapidly planted to orchards. This development is being carried on in all parts of the area, and eventually all lands not too steep to permit cultivation, or with soil

so shallow as not to be adapted to tilled crops, will doubtless be put in orchards.

In order to give an idea of the extent of orchard area and the relative acreage of the different crops in the Hood River Valley, and to determine, if possible, the relation between the plantings and the type of the soil, a plat was made of all of the plantings in that valley. The acreage devoted to the various crops was determined, but the plat showed that there is, as has already been mentioned, scarcely any relation between the plantings and the soil types as recognized in the survey. Owing to the less extensive development in the White Salmon River Valley, no attempt was made to determine the crop acreage in that section.

The following figures have been taken from the plat and are applicable only to that part of the Hood River Valley covered by the present survey.

Acreage devoted to the several crops produced in Hood River Valley.

	Acres.
Forest, logged-off, and slashed land	52,250
Cleared and fallow land	610
Apple trees	16,425
Strawberries	766
Forage crops of all kinds	2,186

The acreage of forage crops includes only those areas where the land was entirely given over to these crops. The larger part of the orchard acreage is sown to some variety of cover crop each fall, which is commonly used for the feeding of farm stock, and as the larger part is plowed under in the spring, it was impracticable to determine the acreage.

The production of strawberries is practically confined to one variety, the Clark Seedling. The single-row system of planting is followed almost exclusively, and the plants are commonly allowed to bear for three years before being removed. In setting the plants the rows are generally made to follow the contour of the land, and irrigation is thus facilitated. (Pl. III.) Most of the strawberries are grown between the rows of fruit trees, and the revenue from the sale of berries is a material aid in meeting the running expenses of the orchard. The yields vary with the care and attention given the vines and with the seasonal conditions. The yields range from 100 to 300 crates per acre. The selling price of the berries is governed by the competition they meet in distant markets, by their quality and size, and by the dates at which they are marketed. The price is usually highest at the opening of the season and gradually declines toward the close.

The larger acreage of berries is on the west side of the Hood River Valley, largely because the yields are better on the soils in that section, while in the White Salmon River Valley the cultivation of this fruit

STRAWBERRIES ON THE WIND RIVER SANDY LOAM, ABOUT 2 MILES SOUTH OF THE TOWN OF HOOD RIVER.

[This illustrates the practice of contour planting for irrigation.]

is confined almost exclusively to the Underwood loam. In the former valley irrigation is practiced wherever berries are produced, as this assures a heavier yield and a longer bearing period. In the White Salmon River Valley water is seldom available for irrigation, and the yields, consequently, average less than those on the opposite side of the river.

In the Hood River Valley the acreage devoted to berries shows a slight decrease from year to year. Most of the plantings are made between the young fruit trees, and as these come into bearing the growing of other crops is discontinued and the soil is given clean cultivation. Eventually the growing of strawberries may decline to a point where it will be of little importance, but in view of the fact that new blocks of trees will be planted for some years to come there is no immediate danger of this. Moreover, there are some soils in the valley that are particularly adapted to this fruit, and a certain proportion of these soils will doubtless be devoted to this crop for many years. As development progresses in the White Salmon River Valley the acreage of strawberries will continue to increase and the growing of this fruit will be one of the important industries of this part of the area.

Prior to the development of the commercial apple orchards in either of these valleys apples had been grown in a large number of small family orchards for several years, and the growth and productiveness of these trees gave some idea of what might be expected from commercial planting in suitable locations.

In the early days of tree planting it was observed that the trees on the west side of the Hood River Valley were not as thrifty as those grown on the east side, and, for some reason, it was supposed that apples could not be profitably grown under irrigation. As a consequence the development of the commercial orchards began on the Hood silt loam, east of the Hood River, and for many years no serious attempts were made to extend the orchard planting west of the river. Later a number of small orchards were planted on the west side of the valley, in spite of predictions of failure, and although there was nothing to guide the planters in handling trees on these soils, their efforts were successful, and the plantings increased rapidly, until at present the larger part of the valley lands west of the Hood River is devoted to the production of apples under irrigation. The returns from bearing orchards gave an impetus to land values, and in the last few years the high prices asked for the lands in the lower valley have forced the development of the upper, or southern, part of the valley and the extension of the planted areas over the slopes of the mountains surrounding the lower lands. In the White Salmon River Valley the earliest orchard development was on the Hood silt loam, where there

had been considerable farming for a number of years. From this section of the valley the planting of trees has been carried to the more level slopes of the Underwood loam, and it is in these sections that the most extensive development is now being carried. The setting out of commercial orchards began less than 10 years ago, and at the present time not more than 5 per cent of the trees are in bearing.

In planting, the trees are set in the square, triangular, or hexagonal systems. Following the square system they are commonly set 26 feet apart. Budded one or two year old stock is invariably used, and the trees are secured either from local nurserymen or from firms or individuals conducting nurseries in the Northwest. Pruning is done each year at any time after the wood is completely dormant, and during the first years of the tree's growth the cutting is such that the tree is held within narrow bounds, in order to facilitate future cultural and picking operations and to build up a sturdy frame that will carry a heavy load of fruit with minimum damage to the branches. Summer pruning is seldom practiced.

In the past there has been a great diversity in the methods of handling the orchards, but although a considerable variation still exists, the growers are generally beginning to use similar methods which experience has shown to be well adapted to the soil and climatic conditions of the region, and to the varieties of fruit most largely grown. With many of the growers the spring treatment of the orchards formerly was to run over the ground with a disk harrow, and to follow this with a harrow or drag. While a few still use this method, the larger number now give the orchard a thorough spring plowing and follow this with successive harrowings until the surface mulch is fine, loose, and deep. In a very large number of the younger orchards, and in some of the older ones, some crop is grown between the rows of the trees during some part of the year. Crops are seldom grown in the older orchards, but it is the common practice to grow a grain or forage crop during the winter. In nearly all cases this is turned under in the spring plowing. In the younger orchards the same practice is frequently followed, but in addition some forage or tilled crop is grown between the trees during the summer season. In the first case the crop is plowed under in the spring, and in the second the returns from the crops go toward meeting the expense of running the orchards. When done judiciously the growing of these crops does not impair the growth of the trees. The danger lies in the temptation to grow these crops after the time when the entire area of the orchard should be used solely for the benefit of the trees.

Considerable differences of opinion have existed in the past regarding the use of winter cover crops. Although various ideas concerning the best crop for this purpose and the methods of planting and handling it, and although there is still much to be learned along these lines, it is

generally conceded that the soils are in need of a greater amount of organic matter, which is most economically supplied by plowing under green crops, and a constantly increasing acreage of orchard land is being seeded down each fall. Oats, wheat, rye, and vetch, sown alone or in various combinations, are commonly used.

Spraying is practiced at various times of the year to combat the pests common to the various fruits. The control of all tree pests and diseases is demanded by the State law, which is enforced by a resident officer, and the fruit in this valley is being grown with as little infestation as in any section of the northwest.

The principal varieties of apples grown are the Spitzenburg, Newtown Pippin, Jonathan, Ortley, Arkansas Black, Gravenstein, and Red Cheek Pippin. A careful canvas of the varieties of apples showed that there were 86 varieties of trees in the valley that were producing fruit. About a dozen of these are important, and the remainder are simply remnants from the early plantings when there was no knowledge of the varieties best adapted to these valleys. A number of years of profitable orcharding has shown the growers what varieties may be expected to give the best returns, and as time goes on there will be a steady removal of undesirable trees.

Alfalfa, clover, timothy, and native grasses are practically the only crops grown for hay in the Hood River Valley. With the exception of an area of rather moist soil in the vicinity of Odell, where there are 100 or more acres in native grasses, the above forage crops are nearly always grown in tracts of 10 acres or less in the vicinity of the numerous farmhouses. These crops seldom produce more than sufficient hay to meet the needs of the individual growers, and a large part of the forage used in the Hood River Valley is shipped in from outside points.

Irrigation is more or less commonly practiced in the Hood River Valley, particularly over the soils on the floor of the valley, but in the White Salmon River Valley the only irrigation is on the Wind River fine sandy loam, as the topography of the other soils is so uneven as to make the construction of canals and distribution of water exceedingly difficult and expensive. In the Hood River Valley strawberries are always irrigated, and a larger part of area in intertilled crops receives one or more applications during the growing season. Apples are not commonly irrigated during the first few years of their growth, but with the exception of some of the older orchards on the Hood silt loam practically all of the bearing trees are irrigated at regular intervals. The water for irrigation is obtained from both the east and west forks of Hood River. The water from this stream is of excellent quality and is more than sufficient for the needs of the valley.

SOILS.

The most important rock formation in this part of the Northwest is known as the Columbia lava, a vast sheet covering nearly 250,000 square miles and varying in thickness from 300 or 400 to over 4,000 feet. This mass of rock was not formed by a single flow or volcanic eruption, but by a series of disturbances, often with a considerable period of time intervening, and the line of separation between the flows is commonly marked either by a change in the structure of the rock or by intervening strata of sands, clays, or gravel. The larger part of these lavas cooled slowly, and wherever vertical sections of the rock are visible a columnar structure nearly always exists. Throughout the gorge of the Columbia River, in this area and to the westward, and along the courses of the Hood and White Salmon Rivers the vertical walls are often 500 feet or more in height. These bold columnar cliffs form a prominent feature of much of the wild, rugged scenery along these streams. (Pl. IV.)

The broad features of the Hood River Valley are structural. It occupies a shallow downward fold or syncline of the basalt beds. Since its formation, however, it has been modified in detail by erosion, both by running water and by glaciers. The work of the latter, however, has been mainly deposition, while the former has done very little beyond the cutting of the narrow valley in which the river flows. Later a considerable part of the glacial deposits were apparently removed, either by streams from the retreating glacier or by others, the forerunners of the present rivers. In some instances the lava was swept clean of its stony mantle and veneered with a deposit of finer sedimentary material, but commonly sections along the gorges of the streams show remnants of the glacial deposits lying between the rock and the later surface soil. Some of the present soil material was probably deposited as glacial outwash, being made up of fine glacial material transported to its present location by streams from the melting ice.

In the White Salmon River Valley it seems doubtful whether glacial ice occupied any considerable part of the depression. So far as has been determined, the present surface of the valley may be solely the result of erosion and deposition by streams, some of which may have been of glacial origin.

In addition to the effects of glacial and alluvial agencies, the lavas have been subject to the slow but certain action of weathering and the decomposition of this rock, where not obscured by deposits resulting from other agencies, has resulted in a mantle of residual soils which cover the crests and slopes of the hills and mountains in the area.

The latest development in the formation of the soils has been the deposition of recent alluvial soil in irregular, narrow areas along

the stream courses. In the White Salmon River Valley there is but little alluvial soil of recent formation, but along the Columbia and Hood Rivers and the tributaries of the latter recent water-laid soils occur in more or less extensive bodies. Overflow along the Hood River and its tributaries is rare and the soil conditions are stable and well defined, but a large part of the recent soils along the Columbia River are overflowed annually and consequently are subject to more or less alteration from year to year.

The soils of the area surveyed thus fall into a number of more or less distinct groups, according to their topographic position and mode of formation. Each group is represented by one or more soil series and each soil series consists of a number of soil types. The latter, within each series, are similar in general characteristics of color, character of subsoil or other underlying material, topography, origin, and mode of formation, but differ in texture as determined by the relative proportions of the different grades of soil material. A complete series consists of a number of associated and closely related soil types ranging in texture from coarse in the sandy members to fine in the silty and clay types. Some of the soil series recognized in this area, however, are represented by but a single soil type.

The soil type is the unit of classification and each type encountered is indicated in color on the soil map accompanying this report.

The residual soils of the area, derived by weathering in place of the underlying rock, are represented by three types—the loam and stony loam members of the Underwood series and Rough stony land. The Underwood soils occur on all of the hill and mountain slopes in the area, and are by far the most extensively distributed soils in the area. The surface soil of the loam type carries noticeable quantities of small, reddish-brown pellets, formed by the cementing of the soil particles by iron salts or by spherical weathering of fragments of basaltic rock. These are locally known as red shot. The stony loam contains large quantities of angular rock fragments in both the soil and subsoil. The color of these soils is commonly a light brown or light reddish brown, with occasional areas of grayish brown, particularly in the bodies adjacent to the White Salmon River Valley. The larger part of the area occupied by these soils supports a heavy growth of fir and pine, but in sections of restricted rainfall and of steep slope and where the drainage is excessive or the soil somewhat shallow these trees give way to scanty growths of oak, brush, and grass. Rough stony land, a nonagricultural type, includes areas in which the quantity of fragmental rock in the soil or of rock outcrop is too great to allow cultivation. The soil is generally thin, the topography is quite steep, much of it precipitous, and the forest growth is usually a scattering stand of pine.

The soils of the area which are recognized as derived wholly or in part from ice-laid material are those of the Rockford and the Parkdale series. The Rockford series is represented by two types, viz, the Rockford stony clay loam and the Rockford clay. The former includes an eroded phase. The typical soil occurs only in the Hood River Valley, though a small body of the eroded phase borders the Columbia River on the Washington side. The type occupies gently undulating or sloping areas slightly elevated above the adjacent soils of the valley floor and carries an abundance of glacial bowlders. The Rockford clay covers only an inextensive area on the western side of the Hood River Valley between the Rockford stony clay loam and the higher lying residual soils of the Underwood series occupying the mountain slopes. Some undifferentiated colluvial and alluvial foot-slope material from the higher mountain soils is included with this type. Rock or gravel is not abundant in the soil, but glacial bowlders occur in small quantities, and are commonly visible along the courses of the minor stream ways. The soils of the Rockford series are of reddish-brown color and are underlain by reddish-brown to yellowish subsoils, overlying deep, compact deposits of glacial till.

The Parkdale series is represented by a single type, the Parkdale loam. This occurs only in the southern part of the area as a dissected plain with a very noticeable slope to the south. The deeper subsoil and substratum is a rocky glacial till, but this is covered by a mantle of finer material. The area occupied by this type resembles in topographic features a glacial outwash plain, and the finer superficial soil material may consist predominantly of stream-laid glacial outwash material of fine sandy and silty texture or of thoroughly weathered material derived from the underlying drift. Streams traversing the plain have cut narrow, rocky gorges into this material and often deeper into the underlying bedrock. The soil is of brown or light-brown color, often with a reddish tint, and usually contains a noticeable quantity of fine pellets. The subsoil is a light-brown to mottled gray and brown silt loam in which the percentage of pellets is generally less than in the soil material.

Of the water-laid sedimentary soils of the area, the most extensive and important is the Hood silt loam, which, like the Parkdale loam, is the only representative of its series recognized in the survey. The origin of this type is not definitely known, but from the depth, uniformity, and fineness of the material it appears to be a deposit laid down in bodies of quiet water, and has probably been derived from fine glacial material. This type is one of the most important soils in the area, and upon it are found the larger number of the productive orchards in these two valleys. This soil is light gray or

light grayish brown in color and entirely free from either rock or gravel.

The stream-laid or alluvial soils of the area are represented by the Wind River, Columbia, and Winans series, and by a nonagricultural type mapped as Riverwash.

The soils and subsoils of the Wind River series are light brown or light reddish brown. The series occupies high terraces, sometimes several hundred feet above the present valley bottoms, and is underlain by a stratum of gravels or of basaltic rock, although this is not generally encountered within the depth of 6 feet. Of this series the stony loam, gravelly sandy loam, sandy loam, loam, and fine sandy loam members have been recognized. These soils are of considerable importance, and occur in both the Hood River and White Salmon River Valleys. (Pl. V.) In one or two instances glacial till deposits occur as a substratum beneath some of the types and a part of the stratified gravels and sands found sometimes in the subsoils may be glacial outwash deposits.

The soils of the Columbia and Winans series and Riverwash are confined to the stream bottoms, and are of recent alluvial origin. The Columbia series is represented only by the Columbia fine sandy loam. This is a light grayish brown or buff-colored soil underlain by stratified alluvial deposits which vary in texture. The parent material is derived from a wide variety of quartz-bearing and quartz-free rocks, and most of it has probably been transported long distances. The type occupies the present flood plain, and much of it is subject to overflow, but where sufficiently elevated above the level of the stream it is cultivated.

The Winans series occupies narrow areas of low terrace and bottom lands in the Hood and White Salmon River Valleys. The soils and subsoils are typically light brown or grayish brown in color and underlain by a substratum of stream-laid gravels. The series is represented by two types, a gravelly sandy loam and a loam. As mapped, however, these two soils include some undifferentiated material which in a more detailed survey, or if occurring in more extensive bodies, would be recognized as distinct soil types. The parent material is derived predominantly from basaltic rocks and much of it has been transported but a short distance.

The gravelly sandy loam is confined to narrow, irregular bodies along the Hood River, and usually occupies areas of low terraces above the present level of the stream channel. This type is very gravelly, the gravel consisting both of glacial and water-worn rock. The formation of the soil is largely due to the reworking by alluvial agencies of bodies of glacial till. The surface is moderately sloping, except immediately along the river, where the land surface often drops abruptly to the level of the stream. The type is traversed by

a few intermittent drainage courses from the higher lands and supports a scant growth of fir, pine, and oak.

The Winans loam is a type of minor importance, confined where typically developed to the Hood River Valley, and occurring as long, narrow bodies of bottom land along the courses of the smaller streams. The texture is extremely variable. The soil is the result of the deposition of material from the flood waters of the bordering streams, and a portion of the type is still subject to alteration by occasional floods.

Riverwash is of no present agricultural importance, and consists of sand and gravel deposits of the Columbia and Hood Rivers. The type is submerged during periods of high water.

The names and extent of the various soils mapped in the area are given below:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Underwood loam	102,080	70.6	Parkdale loam	1,472	1.0
Hood silt loam	14,400	10.0	Wind River gravelly sandy loam	1,152	.8
Rough stony land	4,352	3.0	Columbia fine sandy loam	1,088	.7
Underwood stony loam	4,032	2.8	Winans loam	960	.7
Rockford stony clay loam	1,920	2.3	Wind River stony loam	832	.6
Eroded phase	1,472		Winans gravelly sandy loam	768	.5
Wind River loam	3,328	2.3	Rockford clay	704	.5
Wind River fine sandy loam	2,240	1.5			
Riverwash	1,984	1.4	Total	144,640	.....
Wind River sandy loam	1,728	1.3			
Light phase	128				

UNDERWOOD LOAM.

The soil of the Underwood loam consists of a loam 8 or 10 inches deep and containing a large number of pellets about the size of buckshot. The soil material is generally of fine, smooth, silty texture. The color ranges from grayish brown to reddish brown, and the term "red-shot land" which is locally applied to this soil is not derived from the color of the soil, but from the color of the pellets or concretions. These pellets are usually soft and readily crushed in the fingers when moist.

The subsoil may be either a loam or a clay loam of high silt content, extending to a depth of 6 feet or more. Where the clay loam occurs the surface loam is rarely over a foot in depth. The pellets may be present in the subsoil, but always in smaller quantities than in the surface soil. The soil is quite granular, and the presence of the pellets makes even the heavier phases easy to cultivate.

This soil is one of the main types in both the Oregon and the Washington portions of the area. In the Hood River section it occurs on the slopes of all the mountains in and bordering the valley, and, with

WEST FORK OF THE HOOD RIVER, AT THE HEAD OF THE DEVILS PUNCH BOWL, 1 MILE WEST OF WINANS.

[Note columnar structure of the rock. This is a basalt, and most of the soils in this area have been derived from this formation.]

YOUNG APPLE ORCHARD ON SOILS OF THE WIND RIVER SERIES, HOOD RIVER VALLEY.

the exception of an irregular area of the Underwood stony loam on the summit of the mountains and hills along the eastern boundary of the area, it extends over the summits of all of the ridges in this part of the area. In the White Salmon section the type is even more extensive than on the opposite side of the river, and is found on the hills and mountain crests, and on all of the slopes lying above the floor of the valley proper.

The topography varies considerably. From the soils of the floor of the valley the surface of this type rises with either long, gentle slopes or with slopes too abrupt to permit cultivation, while on the tops of the surrounding mountains there usually are areas where the surface is but slightly rolling, and often nearly level. Rock outcrop is rarely encountered. The presence of rock in the subsoil is usually indicated by a change in the native vegetation from heavily forested slopes to those which are covered with a scanty growth of brush and grass. The drainage is good and in many places excessive.

The Underwood loam is a residual soil derived from the weathering of the underlying basalt. It includes a number of small areas of undifferentiated soils along the base of the steeper slopes, where the material is predominantly colluvial. Such areas are irregular, relatively unimportant, and no attempt was made to indicate them separately in the soil map. In color, texture, and adaptation to crops these bodies do not differ materially from the adjacent soil. Small and unimportant areas of undifferentiated red residual soils derived from the basaltic rocks are also included. In a more detailed survey these might warrant recognition as distinct soils.

The native vegetation varies with the topography and exposure. Over the more level parts of the type a dense stand of Douglas fir is common. On easy slopes there is a mixed forest of fir and pine, and as the slope becomes steeper and the elevation greater the pine and fir give way to oak and brush. On the steepest mountain sides, particularly on southwest exposures, there is only a growth of grasses and weeds.

With the exception of the steeper and rougher slopes, this type is well adapted to the fruits commonly grown in this section. It is utilized principally for the production of apples and strawberries. Intertilled crops are often grown in the younger orchards, and the profit from these often enables the owner of the orchard to meet running expenses until the trees come into bearing.

The value of this soil for agricultural purposes varies greatly, depending largely upon the topography. The steep grass-covered slopes have no value except for the scanty spring grazing they afford, as much of this soil is relatively shallow and the surface is in many places too steep to allow of cultivation. On the other hand, there are areas from 1,000 to 2,000 feet in elevation where the surface is

only slightly rolling and the soil commonly 30 feet or more in depth, and these locations are among the choicest of the type. Between these two extremes there are all grades of soil, and the intermediate phases, which constitute the greater part of this type, are found on hill slopes both above and below the more level areas, on the slopes of the ravines in which the lesser water courses run, and on the slopes of the hills which border the Columbia and its main tributaries.

The following table gives the average results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Underwood loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
560619, 560633.....	Soil.....	0.5	4.1	7.5	11.8	10.5	47.6	18.0
560620, 560634.....	Subsoil.....	.2	3.4	6.3	10.5	10.5	45.7	23.2

UNDERWOOD STONY LOAM.

The Underwood stony loam to a depth of a few inches to 6 feet or more is a light-brown or reddish-brown loam, containing a large quantity of angular rock fragments varying from an inch in diameter to large bowlders. Within 6 inches of the surface the soil usually carries slightly more organic matter than below, and for that reason it is slightly darker in color than the underlying material. Rock outcrop commonly occurs on the crests of the elevations, and the bedrock is often encountered at depths of 6 feet or less in places where erosion has removed much of the soil.

This soil is associated with the Underwood loam and always occupies the crests and steep slopes of the mountains, usually at a greater elevation than that type. The principal occurrence is in the elevated mountainous region along the central-eastern margin of the area, principally adjoining the Hood River Valley. Other smaller areas occur in the vicinity of Dee, and one body is located near the town of White Salmon.

The topography is in general steep and the drainage excessive.

This type has the same origin as the Underwood loam, being a residual soil derived from basaltic lava. It differs from the loam type in the higher proportion of rock fragments and in the generally shallower soil and subsoil.

The forest growth on areas of lower elevation is either oak or oak and pine, while the higher areas have either scrubby oak or are bare with the exception of a scanty covering of grasses.

Owing to elevation and character of surface the type is generally nonirrigable. In the area near the town of White Salmon the topography generally favors the use of the land for farming, but with this

exception the type can hardly be termed desirable agricultural soil and is best adapted to grazing.

ROUGH STONY LAND.

This type includes all areas where rock is present in such quantities as to render the soil nonagricultural, except that portions of the type may be utilized to some extent for grazing. It includes lava gorges through which several of the streams in the area have their courses, areas of rock outcrop on the crests and steeper slopes of the mountains, and recent lava flows. The largest single body of this type is in the southwestern part of the area about 1½ miles west of Parkdale, where one of the last flows of lava from Mount Hood lies as a high, broad, steep-sided ridge 100 to 400 feet above the surrounding country. This ridge rises abruptly from the lower soils and is made up of innumerable angular blocks of lava of varying sizes, which are unweathered and apparently as fresh as though but recently cooled. A few scattering pines are found on the ridge, but these are growing in small pockets where the soil has apparently been lodged by the wind rather than derived from the breaking down of the lava. The remainder of this type, excepting the recent talus slopes at the base of some of the steeper areas, is covered with a scattering stand of fir and pine.

ROCKFORD STONY CLAY LOAM.

The typical Rockford stony clay loam is a clay loam of rather light texture and of light-brown to reddish-brown color, except in localities of deficient drainage, in which the color of the surface is darker. The soil is usually underlain at a depth of about 12 inches by a reddish-brown to yellowish-brown, compact clay loam, in turn resting on a stratum of compact glacial till.

Fragmental rock consisting of glacial bowlders is present in all of this type in such quantities that its removal is necessary before the soil can be cultivated. In a few places the quantity of rock is so large that it is doubtful whether it would be profitable to clear the land. The rock fragments vary in size from pieces only a few inches in diameter to bowlders several feet in diameter.

Typical bodies of this soil are moderately rolling and differentiated from the bordering types by being slightly elevated. The surface drainage is generally good, but subdrainage is somewhat imperfect, owing to the compact subsoil, and in a few places the lack of drainage is indicated by a difference in the color of the soil.

The Rockford stony clay loam occurs typically over the sloping floor of the valley west and southwest of the town of Hood River. One small body occupies a terrace or elevation above Hood River near Dee.

The Rockford stony clay loam is derived from glacial till or morainic deposits laid down at a time when the lower Hood River Valley was filled by extensive ice sheets and left as a blanket of rock and soil on the rocky floor of the valley upon the retreat of the glaciers. Remnants of this material remain on the snow and ice clad slopes of Mount Hood. A part of the material has doubtless been removed by subsequent erosion, and this soil type represents those areas that have resisted removal.

Forests of pine and oak, the latter predominating, originally covered the entire area of this soil. The growth was somewhat open and there was a fair grazing for the cattle belonging to the early settlers. With the extension of the cultivated area parts of the more level areas were cleared and planted with orchard, and at present possibly half of the forest has been removed.

While parts of this type carry so much stone that it is doubtful whether their clearing would prove profitable, the larger part of the comparatively level bodies can be and is being cleared, the rock removed, and orchards set out.

Where the physical conditions of this soil are favorable it is well adapted to the production of the fruits grown in this section. Areas of deficient drainage can be profitably used for growing the forage crops.

Rockford stony clay loam, eroded phase.—The Rockford stony clay loam includes an eroded phase, which is indicated on the soil map by means of ruling. This phase embraces sloping and hilly, rocky lands paralleling the Columbia River west of the town of Hood River, on the Oregon side, and in the vicinity of Bingen, on the Washington side. It carries a greater quantity of rock fragments than the typical soil. The clay loam fine earth may persist to a depth of 6 feet or more, but in most areas the subsoil is a heavier clay loam, or the clay loam may be underlain at less than 6 feet by a mass of glacial bowlders, with some finer material. Where the heavy clay loam subsoil occurs the surface soil is seldom over 18 inches in depth. The stony subsoil is commonly cemented into a very compact mass, which can be broken only by blasting, and owing to its presence portions of this phase are of no agricultural value.

The surface is always sloping, and the slopes are sometimes very steep, although it is not subject to erosion. The larger part of the phase carries rocks in quantities sufficient to prohibit its clearing and utilization for cultivated crops. The boundary between this phase of the type and the bordering higher-lying soils of the floor of the valley is marked by an irregular line, at which the surface of the land begins to drop toward the Columbia River or toward the Hood River. Bodies of this phase are bordered on the side nearest the

river either by the alluvial soil along the streams or by narrow areas of Rough stony land.

The drainage of the phase is commonly deficient. This is due both to the seepage of water from the higher lands and to retarded internal drainage, which frequently results from the presence of the underlying cemented material. A small body of land mapped as the eroded phase of the Rockford stony clay loam and occurring upon the Washington side of the Columbia River in the vicinity of Bingen is of doubtful glacial origin. The area covered is, however, of small extent and of little agricultural value and does not depart greatly from the bodies upon the Oregon side in character of soil, topography, or agricultural utilization.

The tillable portions of the eroded phase are confined to small, scattered areas where the cemented substratum does not lie near the surface and where the amount of rock is not so large as to prevent its economical removal.

The following table gives the average results of mechanical analyses of typical samples of the soil and subsoil:

Mechanical analyses of Rockford stony clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
560615, 560645	Soil	0.7	3.6	5.6	12.2	14.2	41.3	22.5
560616, 560646	Subsoil	.6	3.9	5.7	12.3	14.6	39.8	22.9

ROCKFORD CLAY.

The Rockford clay consists of 6 to 12 inches of a light-brown to reddish-brown clay, with a texture approaching that of a heavy clay loam. The soil is rather compact, but under favorable conditions is capable of being maintained in friable tilth. The subsoil is a compact, tenacious clay, varying from red or reddish brown in the upper to yellowish brown in the deeper part. No gravel is encountered in this type, pellets are rare, and glacial bowlders are present only in small quantities either within the body of the type or along the boundary between it and the Rockford stony clay loam.

In parts of this type the surface soil has a distinct red color, not typical of the Rockford series. The areas of such soil, however, are too small to warrant mapping them as a distinct type.

Only one body of Rockford clay is found in the area. This occurs in the western part of the Hood River Valley, between the slopes of the mountains and the main body of the Rockford stony clay loam. The type occupies a number of well-developed ridges or rolling elevations between which there are a number of small drainage ways, and

while subdrainage is restricted by the compact subsoil, the surface drainage is good.

While recognized in this survey as a member of the Rockford series, the material of which is derived from glacial till and morainic deposits, this type as mapped includes more or less undifferentiated colluvial and alluvial foot-slope material washed from adjacent more elevated slopes occupied by the Underwood loam and the Rockford stony clay loam.

The Rockford clay type is largely cleared of its native vegetation and used for the production of apples, which has met with success despite the heavy subsoil. It is very probable that in those areas where the clay subsoil is most tenacious and lies nearest to the surface the soil would prove well adapted to the pear.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Rockford clay:

Mechanical analyses of Rockford clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
560617	Soil	0.3	2.3	3.9	8.5	9.5	38.9	36.6
560618	Subsoil	.7	2.3	3.9	8.7	11.0	38.6	34.8

PARKDALE LOAM.

The soil of the Parkdale loam, to a depth of 12 inches, is a granular, friable, grayish-brown to yellowish-brown or light reddish brown loam, containing a considerable number of small iron concretions or pellets or spherically weathered fragments of basaltic rock, similar to those occurring in the soils of the Underwood series. The subsoil is similar to the soil in texture, or it may be a mottled silt loam. It very commonly differs from the surface soil only in that the pellets are less numerous and the color is lighter. Material like the subsoil usually extends to a considerable depth below 6 feet. At 20 feet or more below the surface the material, as may be seen in cuts, is a coarse bowlder till, and it is probable that it underlies the entire type.

In general this soil is permeable and the drainage good, but there are small areas where the internal drainage is deficient. In these places the texture of the soil is heavier than normal, and the effect of the excess moisture has been to bleach the materials, forming areas of light-colored or ashy-gray soil.

The Parkdale loam is the prevailing soil of the upper Hood River Valley; that is, that part of the valley above the narrow gorge of the Hood River at Winans. The valley floor constitutes a visibly sloping plain gradually rising toward the south, bordered on each side by

the slopes of the hills and mountains which rise from 1,000 to 2,000 feet above it, and dissected by the several forks of the Hood River. These streams flow in gorges usually 150 feet or more below the general level of the plain, but only the lower 40 or 50 feet of these gorges is cut in the lava bedrock. Laterals from the streams have worked back into the plain and in places have dissected it thoroughly. This causes the topography to vary from broad, smooth-topped ridges to steep slopes, the latter along the stream channels.

At one time practically the entire Hood River Valley was covered with glaciers descending from the upper slopes of Mount Hood. Upon retreating these masses of ice left behind a thick deposit of bowlders, rock, gravel, and soil, which now lies just above the lava bedrock of the country. While the material of the Parkdale series is regarded as derived principally from weathered ice-laid material, certain features of the topography suggest a glacial outwash plain. The melting ice was the source of numerous streams, which naturally carried large amounts of eroded rock material. This would under favorable conditions be deposited as a mantle of varying thickness over the rocky till. In the absence of bowlders and in the general fine, silty character of the superficial material the soil further resembles the material of water-laid sediments, and the soil and subsoil may consist in part or even predominantly of glacial outwash sediments. The underlying glacial till, on the other hand, appears to have been deeply weathered, and the soil may be solely the result of the nearly complete weathering of ice-laid material.

The native vegetation consists of a dense growth of fir upon the ridges, with cedar and a number of deciduous trees in the narrow stream bottoms.

Although this part of the area has been inhabited for many years, it is only within the last five years that there has been any serious attempt to develop it agriculturally. Lack of transportation facilities has been the greatest hindrance to progress in this part of the area, but now that railroad transportation is available the land is being rapidly cleared and put under cultivation. Both hay and orchard crops are now grown, and the conditions are favorable for a considerable extension of the acreage devoted to them. Where the soil is well drained, apples and strawberries do well, but on account of the short growing season, due to elevation, the production of some crops is impracticable. Where drainage is not excessive, the soil is retentive of moisture, and the native grasses, as well as clover and alfalfa, yield well.

The following table gives the average results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Parkdale loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
560604, 560606.....	Soil.....	2.2	5.0	7.4	14.5	12.7	46.7	11.4
560605, 560607.....	Subsoil.....	1.1	4.2	6.7	13.0	10.4	51.2	13.5

HOOD SILT LOAM.

The soil of the Hood silt loam is of light-gray or yellowish-gray color, excepting in a few poorly drained areas, where the color ranges from dark gray to nearly black. The soil is predominantly a silt loam, the silt content, however, being rather low and replaced to a large extent by very fine sand. In many localities it closely approaches a loam or silty, fine sandy loam in texture, and some undifferentiated bodies having a light loam or heavy fine sandy loam texture occur. The variation in texture is, however, not wide, and in general appearance, structure, and relation to agriculture the type is remarkably uniform. A few concretions or pellets occur in places, and where the type adjoins the Underwood loam there has been here and there an admixture of material washed from the slopes occupied by the latter soil.

The subsoil is a loam or silt loam and very much like the soil in texture and color, but there are a number of places in the Hood River Valley where the subsoil is extremely compact, being locally known as a hardpan. This compact material is frequently slightly cemented, and causes considerable trouble in handling the orchards, as it not only hinders the internal drainage of the soil, but prevents the normal development of the tree roots, resulting in a decrease in the vigor and productiveness of the trees.

In depth the soil mass is subject to more or less irregularity. In the White Salmon River Valley, so far as could be determined, it rests directly upon the underlying basalt, which may occur at any depth between 6 and 100 feet. In the Hood River Valley the soil is apparently underlain in places both by deposits of glacial till and by strata of an incoherent, yellowish-brown sand, though neither of these formations seem to occur within 10 or 15 feet of the surface. In the areas of the deeper deposits the substratum underlying the subsoil usually consists of compact, stratified fine sand, fine sandy loam, or more frequently of finer sediments of silty clay loam or silty clay texture. Both soil and subsoil material are free from gravel, bowlders, or other rock fragments, except in a few localities adjoining other soil

types from which a small admixture of such material may have been derived.

The Hood silt loam is found in both of the valleys in this area. In the Hood River Valley it covers the greater part of the lower valley floor between the Hood River and the range of mountains along the eastern boundary of the area. A relatively small area is also found just west of the Hood River, where it occurs in a long, narrow body approximately parallel with the stream. In the White Salmon Valley the type occupies all of the slightly elevated lands along the White Salmon River, from a point about 3 miles north of Husum southward to the Columbia River. It also forms a long, narrow body in the drainage basin of Jewett Creek, a short distance north of the town of White Salmon.

In the Hood River Valley the general slope of this type is from the mountains toward the river. It has a generally uniform surface, but includes a number of low, broad ridges. Along Hood River the type forms in places a nearly precipitous bluff, or slopes more gently to the stream. In the latter case the areas are not too steep for cultivation. In the White Salmon Valley the topography is subject to considerable variation, the type occurring either as relatively smooth slopes above the streams or as prominent knolls and ridges rising toward the mountains on each side.

The drainage is generally good, though where the soil is unusually compact the internal movement of water is retarded. In an area in the vicinity of Odell the surface drainage is but partially developed. Here the artificial drainage may be provided by digging ditches and laying tiles, but where the compact subsoil is found blasting will have to be employed to improve the conditions.

The origin and mode of formation of this type is not altogether clear, but it seems to have been derived from old sedimentary deposits laid down over areas of basalt or glacial till. In the White Salmon Valley the substratum of till is apparently absent, but the similarity of color, texture, and structure in the bodies of this soil on both sides of the Columbia River indicate a similarity in the method of formation of the soil proper.

The uniform fineness of the material suggests that it was deposited in quiet waters. The deposition probably took place in sheltered bays or estuaries occupying the valleys during a period of depression. One or more periods of relative depression are believed to have taken place subsequent to the active period of glaciation. At such times the waters of the Columbia and its tributaries must have backed far up the valleys.

The deposits probably consist mainly of glacial sediments derived from basaltic and andesitic rocks and carried into the area of deposi-

tion by the streams draining the high glacier-clad peaks. There may also have been an admixture of volcanic ash deposited directly in the waters or eroded from adjacent slopes, and the material may include some alluvial valley filling washed from the slopes of adjacent more elevated soils.

In the White Salmon Valley a greater part of the type was originally covered with a dense stand of fir, and along the stream courses heavy growths of deciduous timber and underbrush were always present. Much of this forest still remains, but it is now rapidly disappearing before the agricultural development of the valley. In the Hood River Valley the native vegetation included pine and scattering oak, with but little brush and grass, and at present comparatively little of the original forest remains. With but few exceptions, this part of the type is devoted to the production of fruit, the only other crop being a small amount of forage grown between the fruit trees or on the moist lands in the vicinity of Odell.

Where adequately drained this type of soil is well adapted to the production of apples. Where the soil is unusually moist forage crops do exceptionally well, and in this area, where there is such a lack of these products, the prices obtained are sufficiently high to warrant the use of all such areas for hay and forage production.

The following table gives the average results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Hood silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
560625, 560641	Soil	0.4	2.4	4.8	9.6	20.3	48.8	13.6
560626, 560642	Subsoil	.1	.8	1.9	7.8	26.6	42.8	19.8

WIND RIVER STONY LOAM.

The Wind River stony loam consists usually of 6 feet or more of a light-brown to reddish-brown heavy loam. It is generally granular and friable, and contains large quantities of rock, consisting of subangular fragments of basalt scattered over the surface and throughout the soil profile. In places this coarse material is so abundant that it is impracticable to clear the land. Some areas have a rather shallow soil and are underlain by basaltic rock in place. Here a small amount of undifferentiated residual material may be included with the alluvial soil.

This soil occurs as a single body occupying a bench or terrace in the White Salmon Valley, lying about 600 feet above the level of the Columbia River. On the west and north sides it merges with the

rolling hills and mountain slopes covered with the Underwood loam. The topography is sloping to gently rolling, and the drainage is good.

This is an old alluvial soil, deposited at a time when the flood plain of the Columbia River stood at this level. The color and structure of the soil and the nature of the embedded rocks indicate that much of the material of this type has not, however, been transported for any considerable distance, and the superficial soil material has doubtless been derived, at least in part, from recent alluvial wash from near-by sloping areas of the Underwood loam.

The forest on this type consists of fir, pine, and scrubby oak, but the larger part of the area originally forested has been cleared and the land set in orchards. The uncleared areas are very rocky and it is doubtful whether it would be profitable to clear and plant these sections. With one or two exceptions, none of the orchards are in bearing, and those that have reached the bearing age have not been producing for a sufficient length of time to determine the value of this soil in the growing of apples. The development of the trees indicates that the soil is well adapted to them, but some doubt is expressed as to the ability of the type to maintain heavily bearing orchards without the aid of irrigation. No water is now available and it will be difficult to supply, owing to the position of the type.

WIND RIVER GRAVELLY SANDY LOAM.

The surface soil of the Wind River gravelly sandy loam consists of from 6 to 18 inches of a light-textured, friable sandy loam, usually containing a relatively high proportion of silt and very fine sand. It is light brown to reddish brown in color, and carries a large quantity of fine gravel, mainly small red pellets, concretions of spherically weathered basaltic particles. The subsoil is either a sandy loam similar in texture to the surface soil, or a loamy sand showing more or less stratification and carrying varying quantities of fine, subangular or waterworn gravel. In places the sandy loam subsoil has the same color as the surface soil, but it is more commonly a lighter brown or yellowish brown. The loamy sand subsoil is always gray. The gravel of the subsoil is made up of small rock particles which have been rounded by the action of water.

In extent this is one of the minor types of the area. It is developed in four small bodies. The area nearest Hood River has a very uniform surface, except along the course of Indian Creek, where there is a sharp descent to the bed of that stream. The body in the White Salmon River Valley also has a uniform surface, which slopes sharply from the hills toward Jewett Creek and the basaltic cliff overlooking the Columbia River.

The drainage of this type is always good, and in places where the sandy subsoil lies near the surface it is excessive. The topography

and character of the material indicate that the type is of alluvial origin. It may, however, include more or less glacial outwash material.

Originally the type was covered with a mixed forest of oak and pine, but owing to the nearness of the areas to the principal towns in the area they have all been cleared, and are occupied by town dwellings or used for farming.

Owing to its low power to hold moisture the Wind River gravelly sandy loam is of little value for cultivated crops without irrigation, but with irrigation apples and berries do well, attaining as good size, color, and flavor as the fruits grown on some of the heavier soils in the area. For the production of vegetables and truck crops under irrigation, this soil is almost as valuable as are the alluvial soils along the Columbia River.

The following table gives the average results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Wind River gravelly sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
560612, 560629	Soil	9.3	15.8	7.9	6.8	12.2	37.8	10.1
560613, 560630	Subsoil	9.9	27.9	13.4	6.4	9.9	23.1	9.4

WIND RIVER SANDY LOAM.

The soil of the Wind River sandy loam is a sandy loam of light-brown to reddish-brown color and of open, porous structure. The subsoil is similar in texture and structure to the soil material, but somewhat lighter in color in the lower depths. The subsoil is underlain at varying depths below 2 feet by a stratum of grayish gravelly loamy sand, similar to that underlying other members of the series. The soil differs from the gravelly sandy loam of the same series principally in the absence of the fine red pellets, though apparently identical with it in origin and mode of formation.

An irregular body of this soil lies south and southwest of the town of Hood River, and two small bodies are found in the White Salmon River Valley north of the town of Underwood.

When first cleared of the fir and oak forest this soil was devoted to the production of strawberries. The berry fields are now giving place to apple orchards. Irrigation is generally considered necessary for the profitable production of these fruits. Water is required by the strawberry throughout the growing season, but in a large number of the orchards no water is applied until the trees come into bearing.

Wind River sandy loam, light phase.—The Wind River sandy loam, light phase, consists of a porous, slightly coherent sandy loam, carry-

ing sufficient quantities of finer material to render it slightly sticky when wet. The color varies from a light brown to a yellowish or reddish brown and, as the surface soil usually contains some organic matter, its color is darker than that of the subsoil. In texture and structure the subsoil is usually similar to the soil material. On account of the light, loose, incoherent nature of the soil, it is subject to drifting when the surface is not protected. Beds of stratified sand and fine gravel are commonly present at varying depths below 6 feet.

One body of this phase of the Wind River sandy loam occurs south of the town of Hood River, near the center of a large body of the typical soil. Near by are a number of smaller bodies of the phase, but as they are seldom more than an acre or so in extent it is impracticable to show them on the map. The surface of the soil is very uniform. Drainage is excessive.

The soil is almost entirely under cultivation, and when properly handled it has proved well adapted to the production of apples and strawberries. It would also give excellent results with truck crops. Owing to the sandy nature of the type, the addition of organic matter in some form is necessary in the production of all crops. The soil also requires copious irrigation.

The following table gives the results of mechanical analyses of the soil and subsoil of the typical Wind River sandy loam and of a single analysis of the soil of the light phase of the type:

Mechanical analyses of Wind River sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
Typical:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
560601, 560639.	Soil.....	3.9	14.5	20.2	17.9	9.9	22.5	11.1
560640.....	Subsoil.....	6.3	20.2	22.6	13.6	7.5	20.3	9.4
Light phase: 560602.	Soil.....	0.4	12.0	27.0	28.2	9.7	14.9	7.8

WIND RIVER FINE SANDY LOAM.

The soil and subsoil material of the Wind River fine sandy loam is a friable, brown or light-brown fine sandy loam, containing a relatively large proportion of coarse and medium sand. The material is not marked by any decided change in color or texture, though the shade of brown becomes somewhat lighter with depth. Basalt rock underlies the type and seems to have an extremely irregular surface, so that the depth of the soil is subject to sudden variations. In many places the soil is but a few inches in depth, and rock outcrop is common, while within a short distance it may be 10 or 12 feet deep. Some fine, waterworn gravel, derived from higher lying masses of volcanic rock, is present in places, but seldom in sufficient quantities

to be of any importance. The pellets conspicuous in most of the other members of the Wind River series are wanting.

The type occurs on the nearly smooth, sloping floor of the upper White Salmon River Valley, in the extreme northern part of the area, and as a single small body in the Hood River Valley, about 2 miles west of the town of Hood River.

The drainage is usually good to slightly excessive. The underlying rock in the White Salmon River Valley consists of a sheet of basaltic lava of recent date, the surface of which, over much of the area covered by this soil type, is marked by irregular mounds of protruding rock with intervening depressions partially filled with soil material. The irregularities of surface have doubtless been caused by steam, the mounds often appearing as steam blisters from a few feet to a few rods in diameter. Owing to this structure excessive subdrainage is a general characteristic of the soil type, and, unless there is a considerable depth of soil to act as a reservoir for moisture, irrigation or rain water rapidly percolates below the reach of plant roots.

The soil is apparently of alluvial origin and without relation to the underlying lava. It is not, however, in all respects typical of the Wind River series, and further field studies may warrant placing it in a distinct series. The material is apparently derived mainly from basaltic rocks, and it seems probable that following the filling in of the valley depression by the flow of lava in the White Salmon River Valley, a stream, now represented by the White Salmon River, followed a course across the lava and deposited a mantle of sediment derived from the material eroded from the soils and rocks on the southern and southwestern slopes of Mount Adams. In the Hood River Valley the soil occupies a small area of elevated terrace and is a remnant of an old elevated plain of the Columbia River. It is not unlikely that some material derived by weathering of the underlying basaltic rock has been mixed with the alluvium, but the basalt where exposed shows little evidence of weathering.

The original forest growth on this type consisted of pine, with but little undergrowth of brush or grass. The stand of pine was scattering, on account of the scanty supply of moisture, in marked contrast to the heavily forested and brush-covered slopes of the bordering mountains, where the depth of the soil and the presence of moisture are favorable to the growth of trees.

On account of the shallowness of much of this type, the area of cultivable land is small. It is only in those parts where the soil is of considerable depth that any cultivation has been attempted, and then only with the aid of irrigation. Hay crops, such as native grasses, alfalfa, and clover, do well and are grown for the feeding of work animals or dairy stock. Some fruit, including apples, crab

apples, and strawberries, are grown, but in the upper White Salmon River Valley the commercial planting of these fruits is attended by considerable risk, owing to elevation and consequent increased danger of late spring frosts.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Wind River fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
560623	Soil	4.6	10.8	8.7	17.6	13.4	34.8	10.1
560624	Subsoil	3.6	9.6	8.6	18.1	13.9	36.1	10.1

WIND RIVER LOAM.

The soil of the Wind River loam consists of a friable brown to dark reddish brown loam, carrying appreciable quantities of small red pellets. The subsoil is in most cases of a lighter brown color, though generally similar to the soil in other respects. Occasionally it is a light-gray, more compact loam. It is usually underlain by a stratified grayish sand, often containing small quantities of fine, waterworn, and subangular gravel, and such material may displace the heavier subsoil at depths ranging from 12 inches to 6 feet.

Three bodies of this type occur in the lower Hood River Valley, west of the river, the largest development being east and northeast of Oak Grove. The other bodies in this valley are not far from the town of Hood River, to the west and southwest. In that part of the area lying in Washington the type occurs in the middle and upper parts of the White Salmon Valley.

The topography varies from smooth to rolling. The body of the type near Oak Grove has the more rolling surface, being cut by a number of small intermittent drainage ways leading to the river. The type usually has an elevation of several hundred feet above the present stream valleys. In the smaller body of this soil, about 3 miles southwest of the town of Hood River, the surface is somewhat lower than that of the surrounding soils and the drainage outlets are inadequate. With this exception the drainage of this type is very good.

The soil is apparently the result of alluvial agencies, but the material may be in part outwash material from former glaciers.

Originally the type supported a moderately heavy stand of fir, with a scattering of oak in places, and a rather thin growth of grass and small brush. At the present time, in the Hood River Valley, all of the forest has been removed and the land is largely in orchards.

In the White Salmon Valley most of the land is still uncleared and on much of it a heavy stand of fir remains.

With the exception of the body where the drainage conditions are not well established, all of this soil is well adapted to the production of large and small fruits. In the moister areas forage crops yield well. It is utilized mainly for the production of apples, strawberries, and grain and hay crops.

The following table gives the average results of mechanical analyses of the soil and of a single analysis of the subsoil of this type:

Mechanical analyses of Wind River loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
560621, 560647....	Soil.....	1.5	5.9	7.7	12.3	11.2	45.9	15.4
560622.....	Subsoil.....	.7	4.7	8.1	12.5	12.1	39.5	22.3

WINANS GRAVELLY SANDY LOAM.

The soil of the Winans gravelly sandy loam varies widely in texture, but it is typically a light-textured, light-brown or grayish-brown sandy loam containing a large quantity of subangular to well-rounded cobbles, bowlders, and gravel. The subsoil is similar in color, texture, and structure to the soil and generally extends to a depth of 6 feet or more. It is underlain by a stratum of waterworn gravel, cobbles, and sand, sometimes at a depth of less than 6 feet.

This is one of the less important types of the area, being found in only a few small bodies along the Hood River. It occupies bottom lands in recent narrow stream valleys, but is generally elevated several feet above the stream channel and is not subject to overflow.

The type varies from small areas of soil of fairly uniform surface to long, narrow areas where the surface slopes sharply toward the stream. The areas are commonly marked by former stream channels.

The Winans gravelly sandy loam is a rather recent alluvial soil, composed of material probably derived mainly from near-by areas of stony glacial till.

The agricultural value of this type is dependent upon the quantity of fragmental rock in the soil, the character of the forest, and the regularity of the surface. It is not an important agricultural soil but is utilized to some extent for the production of apples, strawberries, and hay crops. The larger part of the type is rather porous, and excessively drained, and without irrigation is not well adapted to the production of orchard or forage crops.

The following table gives the results of a mechanical analysis of a sample of the soil of this type:

Mechanical analysis of Winans gravelly sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
560603	Soil	8.9	20.7	15.5	22.1	9.3	16.7	6.8

WINANS LOAM.

The texture of the soil of this type shows a wide variation, not only between the different bodies but also within narrow limits in each body, and the type as mapped includes small areas of sandy loam and of light clay loam texture. The prevailing soil, however, is a fine, smooth, slightly sticky loam. The color of the soil and subsoil is also subject to considerable variation, but is typically grayish brown to reddish brown. Waterworn basaltic gravel may or may not be present in the type, and where encountered it is most abundant in the subsoil. The subsoil is generally similar in texture and structure to the surface soil and of slightly lighter color. It is underlain by a stratum of waterworn, stream-deposited gravels.

The surface of this type is smooth, sloping, and broken only by the present streams and by a few swales that indicate the courses of former drainage ways. In general the type is lower than the surrounding soils, from which it is usually separated by an abrupt terrace, 10 feet or more in height. On account of the low position of the larger bodies of this soil, drainage is commonly deficient. Small areas of the soil are occasionally overflowed.

The principal areas of the Winans loam are long, narrow strips occupying the bottoms along Neal, Odell, and Phelps Creeks and the East Fork of Hood River in the Hood River Valley. One small body occupies stream terraces in the vicinity of Husum in the White Salmon River Valley. A part of this area forms a somewhat higher terrace than do the typical areas, and the soil has a dark-brown color and a much heavier texture.

The soil is alluvial and of rather recent origin, having been deposited by the earlier activities of the present streams. The material composing it has been derived from the mountain slopes, where the Underwood loam is the prevailing type of soil.

The native vegetation, which included fir, pine, cedar, and deciduous trees and brush, has been largely removed and the land devoted to forage and orchard crops. The pear has been most generally planted on this soil. Although this fruit will withstand rather adverse conditions, the high moisture content of this soil and the

greater likelihood of late spring frosts, owing to low elevation, make it a poor fruit soil and not well adapted to commercial orchards. This soil is well suited to clover and alfalfa, and it should be devoted chiefly to these or similar crops.

COLUMBIA FINE SANDY LOAM.

The soil of the Columbia fine sandy loam is predominantly a porous, friable fine sandy loam of light grayish brown to buff color. The subsoil is generally similar in color, texture, and structure to the soil material, and is underlain at varying depths by stratified stream-laid sands and by basaltic bedrock.

The soil is alluvial and has been formed by deposition of material from overflow waters of the Columbia River. Owing to the varying nature of the materials carried by the stream, and the irregularity with which they have been laid down, the structure and texture of the type is subject to considerable variation, even within small areas. Near Bingen the prevailing soil is a moderately fine sandy loam, in which small amounts of fine waterworn gravel sometimes occur. On the south bank of the Columbia River, from the mouth of Hood River eastward to the boundary of the areas, the soil is usually a very fine sandy loam, free from gravel or rock. West of the mouth of Hood River it is a heavy fine sandy loam, and in small areas almost a silt loam. In some small areas this type is uniform to a considerable depth, but in general the soil is made up of a number of thin strata of material varying from fine sands to silt loams. Gravel and bowlders are decidedly rare in this soil, being encountered only in the body of the type near Bingen, and even here the amount of the coarser material is too small to be of any importance.

The Columbia fine sandy loam type is confined to the flood plain of the Columbia River, and occurs on both sides of that stream. On the Washington side of the river there is but a single area near Bingen, while on the Oregon side areas are numerous, though only small areas occur east of the mouth of the Hood River.

None of this type is more than a few feet above the usual level of the streams. The land rises from the water's edge with a gentle slope, broken only by occasional sloughs. The drainage of the type is good to deficient, depending upon the elevation of the surface above the general level of the water. Some of the lower lying areas are subject to overflow during periods of high water.

The type is made up of sediments carried by the stream during flood periods. Some of the material has probably been transported great distances and is derived from a variety of quartz-bearing and quartz-free rocks. Mingled with this is some basaltic material derived from regions adjacent to the survey.

Originally all the type was covered with a dense growth of cottonwood, willow, alder, and underbrush, and over most of its area this growth still remains. Occasional areas of the soil are devoted to grain or various tilled crops. The ease with which it may be cultivated and the abundance of moisture make it a valuable soil for truck and forage crops.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Columbia fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
560627	Soil	0.2	0.7	0.7	19.0	52.1	24.0	3.4
560628	Subsoil	.0	.0	.1	15.4	42.2	34.3	7.8

RIVERWASH.

Riverwash includes the sand and gravel beds in the Columbia and Hood River flood plains. At the mouth of Hood River, and in various places along its course, this type often consists merely of beds of waterworn cobbles, gravel, and sand, but along the south bank of the Columbia River it includes extensive deposits of a grayish to yellowish fine sand. The areas lie but little above the usual level of the water in the streams, and in the spring practically all of them are under water.

Owing to the danger of overflow and the usual light, gravelly nature of this type, it has no agricultural value.

SUMMARY.

The Hood River-White Salmon River area comprises about 226 square miles, or 144,640 acres, in and adjoining the Hood River Valley in the State of Oregon and the White Salmon River Valley in the State of Washington.

The former part of the area lies in Hood River County in the north-central part of Oregon. The limits of the agricultural part of the valley are marked by the character or degree of slope and by the elevation of the surrounding mountains. All of this part of the area lies within the drainage basin of the Hood River and its tributaries.

The larger part of the Hood River Valley is made up of elevated stream terraces and plateaulike areas, the surface of which varies from smooth and sloping to slightly rolling. The hill and mountain soils rise directly from the floor of the valley and have a surface varying from moderately to steeply sloping.

All of the Hood River Valley section of the area was originally covered with a heavy growth of fir and pine. Although the larger part of the hill and mountain slopes remain in forest, the comparatively level soils of the valley have been largely cleared and the land devoted to cultivated crops.

The White Salmon River Valley lies in the southern part of the State of Washington, in both Klickitat and Skamania Counties, and is separated from the Hood River Valley section by the Columbia River. This part of the area is drained by the White Salmon River and tributary streams. The larger part of this section of the area is made up of the mountain slopes. The suitableness of the land for cultivation is governed by the degree of slope and the depth of soil. An irregular belt of soil along the White Salmon River, lying at varying elevations above the level of the stream, supports the oldest and most extensive agricultural development in this part of the area.

Hood River is the largest town in the Hood River Valley section, and White Salmon is the principal town of that part of the area lying north of the Columbia.

Transportation is furnished by lines of railroads along both banks of the Columbia River, and by a number of steamers which ply between The Dalles and Portland.

The climate is characterized by moderately cool summers and mild winters. The annual rainfall averages about 40 inches. The average velocity of the wind is high, but destructive winds are unknown.

The first settlers were interested largely in stock grazing, but as the population increased the land was cleared and devoted to a number of cultivated crops. The success which attended the growing of fruits has led to a steady development of that branch of agriculture, and at the present time practically the only agricultural export consists of apples and strawberries. The development has been most rapid in the Hood River Valley, as transportation facilities in that part of the area have been adequate for many years.

Irrigation is practiced over a large part of the soils in the Hood River Valley, the waters being diverted from the forks of the Hood River. In the White Salmon Valley only a small part of the land in the extreme northern part of the area is irrigated, and, owing to the difficulties of obtaining water for the larger part of this valley, it is doubtful whether any considerable area will ever be irrigated.

Land values in both valleys are rather high.

The soils in these valleys are either residual, glacial, or alluvial. Sixteen types have been recognized and mapped.

In the residual group three types are recognized—the loam and stony loam members of the Underwood series and Rough stony land. The Underwood soils are by far the most extensive in the area and

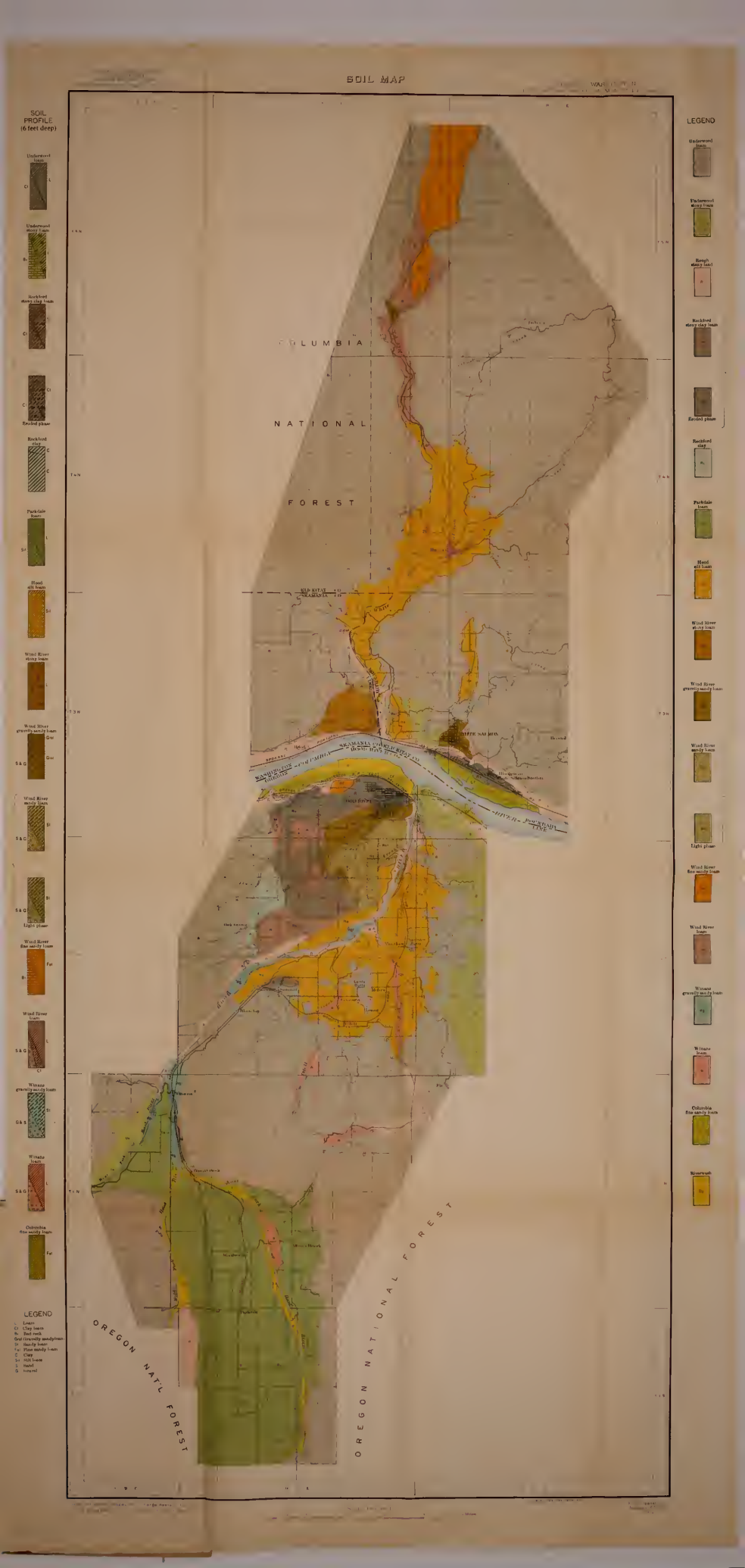
occupy the hill and mountain slopes. The larger part of their area is forested. The Rough stony land is a nonagricultural type.

The glacial group includes the Rockford and Parkdale series. The Rockford series is represented by two types—a stony clay loam, including an eroded phase, and a clay. The loam is the only soil of the Parkdale series in this area.

The Hood silt loam is the only representative of its series, and consists of a water-laid sedimentary soil derived from fine glacial material. It is one of the most important soils of the area.

The alluvial soils comprise three series—the Wind River, Columbia, and Winans—and the miscellaneous type, Riverwash. Of the Wind River series, the stony loam, gravelly sandy loam, sandy loam, loam, and fine sandy loam members are mapped. These soils are of considerable importance. The Columbia series is represented only by the Columbia fine sandy loam and the Winans series by the gravelly sandy loam and the loam, neither of which are extensive. Riverwash is an unimportant type, consisting of sand and gravel deposits.

SOIL MAP


SOIL PROFILE (6 feet deep)
LEGEND
COLUMBIA
NATIONAL
FOREST
OREGON NAT'L FOREST
OREGON NATIONAL FOREST

[Public Resolution—No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]